Population Survey of the Nahanni Wood Bison Population, March 2011

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ABSTRACT

The Nahanni wood bison (*Bison bison athabascae*) population was established in 1980 with the release of 28 wood bison from Elk Island National Park (EINP) into the Nahanni Butte area of their historical range. Supplemental releases in 1989 and 1998 of 12 and 59 individuals bolstered the population. Limited aerial surveys were conducted in the 1990s to monitor the population, but the first systematic aerial line transect survey to estimate the population size was not conducted until March 2004. In March 2011 we flew a similar aerial line transect survey to estimate population size; more bison were observed being distributed throughout the *ca.* 7,600 km^2 survey area. We used radio collared bison to provide a sightability correction factor for the 2011 survey. The population estimate was 431 bison (± 213 95%CI; CV=0.247), which was similar to the 403 bison (± 256 95%CI; CV=0.320) estimated from the 2004 survey. In addition to the 186 bison, 79 moose and one otter were observed during the survey.

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INTRODUCTION

The Nahanni wood bison population was established in 1980, when an initial 28 wood bison from Elk Island National Park (EINP) were released into the Nahanni Butte area near the Mackenzie Mountains in the southwestern Northwest Territories (NWT) (Gates et al. 2001, Figure 1). Supplemental releases of 12 and 59 animals in 1989 and 1998, respectively, bolstered the population. Currently the population has established itself along both sides of the Liard River Valley from the Poplar River southward to northeastern British Columbia (BC), north up the Kotaneelee River Valley to 60° 40'N, and southward into northeastern BC along the Liard Highway.

Non-repeatable aerial surveys of primary bison range were conducted in 1995, 1996, and 1997 to monitor the population and to generate a minimum population estimate (Larter and Allaire 2007). In 1998 the Nahanni population was estimated to number *ca.* 160 individuals (Gates et al. 2001). In response to concerns from residents in the communities of Fort Liard and Nahanni Butte about the lack of monitoring of the Nahanni wood bison population and the need for a current population estimate, a systematic aerial line transect survey to estimate population size was conducted in March 2004 (Larter et al. 2007). The March 2004 survey area boundaries were delineated based upon compiling all current and historic observation information from local residents of Nahanni Butte and Fort Liard and from scientific knowledge. The resulting survey area covered 5,082 km^2 of winter range with 3,350 km^2 in NWT, 1,253 km^2 in BC, and 479 km^2 in Yukon Territory (YT). In 2004 the population was estimated

at 403 individuals. Based upon the results of the 2004 survey, it was recommended that satellite and/or global positioning system (GPS) collars be deployed on bison in the Nahanni population in order to better assess their distribution, to clearly define a survey area and to provide information for a sightability correction factor for future surveys (Larter et al. 2007). A sightability correction factor had been used for some surveys of the Mackenzie population to more accurately account for animals that were present but not counted in forested habitats (Larter et al. 2000).

Satellite and GPS collars were deployed on seven adult bison (six females and one male) in February and March 2011 prior to a second systematic aerial line transect survey. The collared animals were used to provide a measure of the sightability of bison in closed forested habitats that was used to derive the population estimate. This report describes the March 2011 aerial survey of the Nahanni wood bison population and provides an estimate of the population size.

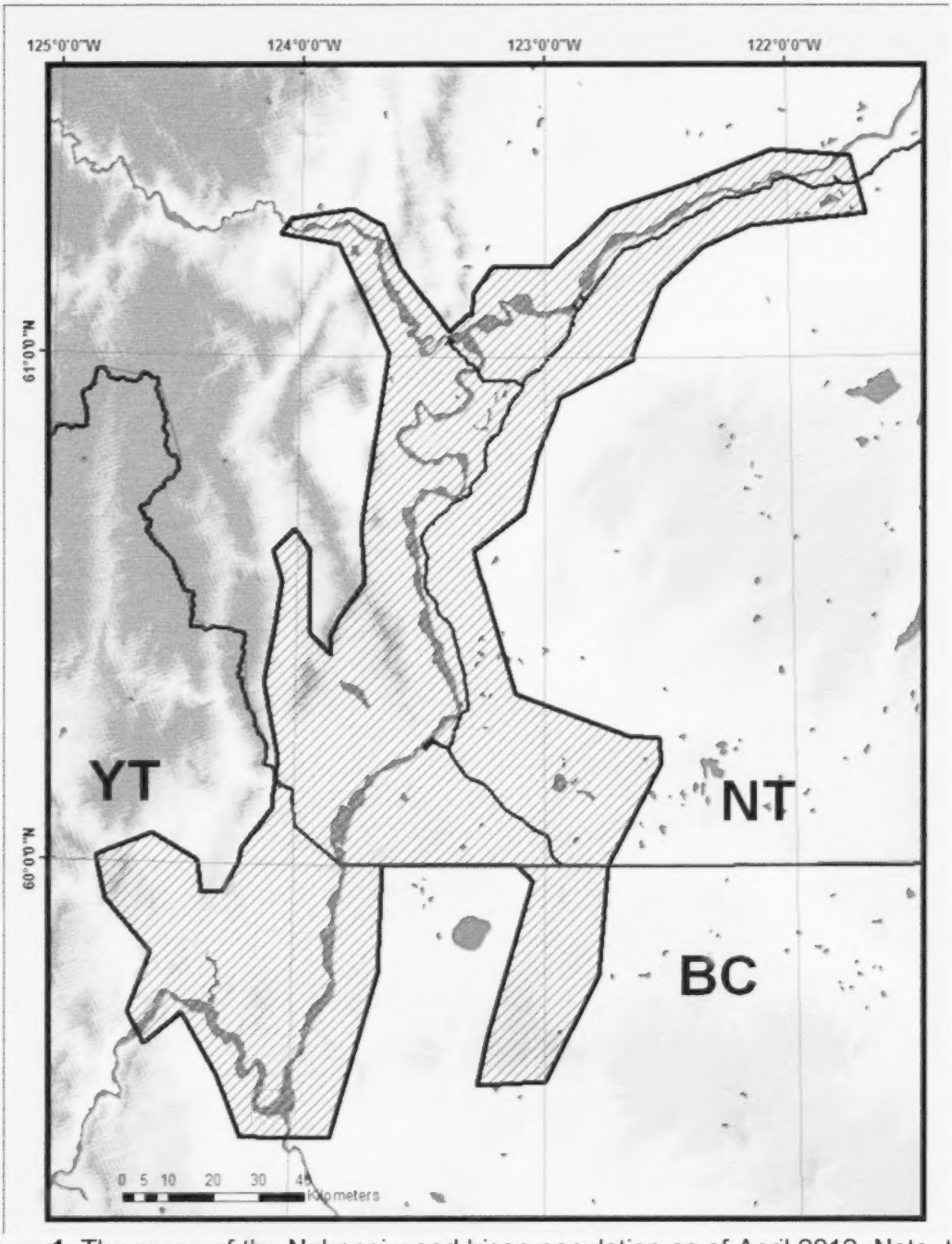

Figure 1. The range of the Nahanni wood bison population as of April 2012. Note: this range is larger than the area surveyed in March 2011 because more recent observations of animals and locations of collared animals extended the range.

METHODS

During 8 to 12 February 2011, six bison (one male and five females) were captured according to the standard operating procedures of the NWT Wildlife Care Committee and outfitted with either ARGOS Doppler shift (DS) or Global Positioning System (GPS) satellite collars (Telonics, Mesa, AZ, USA and Service Argos, Landover, MD, USA). A sixth female was equipped with a DS satellite collar on 8 March 2011. DS collars provided six to eight locations daily, while GPS collars provided four locations daily. Locations were used to assist in delineating the survey area. All collars have a standard VHF beacon with a unique frequency within the 150-151 MHz range. We used the VHF to locate collared animals during the survey.

We provided maps of the 2004 survey area to local First Nations from Nahanni Butte and Fort Liard as well as to biologists from NWT, BC, and YT and local air companies. We compiled all recent observation and location data from collared bison with comments received from other parties to delineate the survey area. The 2011 survey area included a larger area of northeastern BC and a wider area along the Liard River Valley between Fort Liard and Nahanni Butte than the 2004 survey. It also included the Liard Highway corridor down to km 118 of the BC side (Highway 77). The survey area boundaries were finalized after community meetings (Figure 2).

Parallel line transects, running in an east-west direction, were situated *ca.* 3.5 km apart on the survey area in such a way as to maximize the number of transects and

minimize the range in transect length (Figure 2). We flew in a fixed-wing aircraft (Cessna 185) with markers on the struts, which enabled each of the two rear seat observers to view a swath of 500 m on either side of the aircraft. All bison observed both within and outside the area bounded by the strut markers were recorded and given a waypoint using a handheld GPS, by the navigator/observer in the front right seat. All wildlife and recent wildlife sign (tracks and feeding craters) were also recorded and given a waypoint. The aircraft flew at a height of 122 m (400 ft.) above ground level (agl) and we attempted to maintain a speed of 160 km/h.

For the Liard Highway corridor, we flew "spaghetti" transect south from the Fort Liard access to km 118 of the highway in northeastern BC and back. The aircraft flew at a height of 122 m agl and provided observers a swath of 750 m on either side of the road. All flight lines were recorded using a handheld GPS (Garmin 76S) programmed for automatic waypoint recording.

While flying the survey, the navigator/observer also used an ATS receiver to listen for VHF frequencies that could help locate the seven collared animals. Only the navigator/observer knew whether or not a collared animal had been seen and included it in the count. In the case of an animal being missed, the navigator instructed the pilot to return to the location indicated by the telemetry equipment to verify the presence of a collared bison, the habitat type it was located in, and estimate the distance it could be observed from the aircraft at 122 m agl.

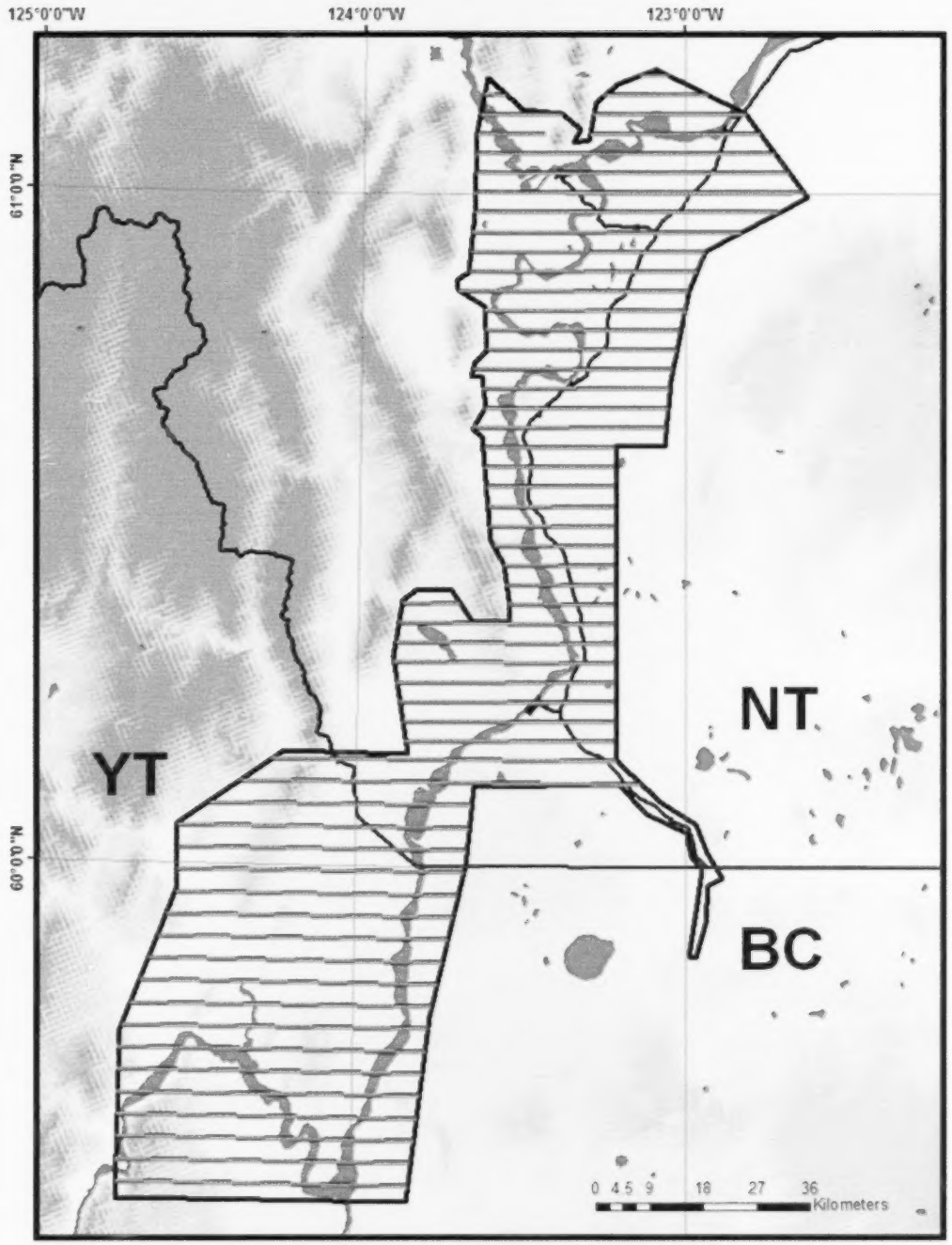

Figure 2. The survey area and 55 parallel transect lines; transect 1 to the south.

Observation data with its associated location were entered into Microsoft Excel (Microsoft Corporation, Redmond, WA) spreadsheets. Location data and digital flight lines were entered into ArcGIS 10 (Environmental Systems Research Institute, Inc., Redlands, California, USA) for mapping. We used the Jolly (1969) method for unequal sized sampling units, following Norton-Griffiths (1970), found in the aerial survey methods of quadrat sampling in Krebs (2011) to generate population estimates. Because calves born in the previous summer had survived through March, they were assumed to be recruited into the population and therefore calves were included in the population estimate.

RESULTS

The total winter range survey area was 7,590 km^2 with 4,308 km^2 (57%) of the range falling within the NWT, 2,797 km^2 (37%) of the range falling within BC, and the remaining 485 km^2 (6%) of the range falling within YT (see Figure 2). We flew 55 line transects totalling 2,155 km over the Nahanni bison winter range; 1,286 km of line transects in the NWT, 749 km of line transects in BC, and 120 km of line transects in YT (Figure 2). The percent coverage of the entire survey area was 22.8% when taking the sightability correction factor into account. We counted 93 non-calf bison and 5 calf bison on transect (Appendix 1), observing 186 bison (174 non-calf and 12 calf) in total (Figure 3).

Four collared female bison were located in open meadow habitat in groups that fell within the 500 m swath on each side of the aircraft and were counted by the observers. Two collared female bison were located in semi-open habitat *ca.* 1 km from the aircraft. These females were not counted by the observers until the aircraft flew towards them after completing the transect to verify their location based upon the VHF. The collared male was not observed and counted by the observers even though it was on transect in dense forested habitat. The male was not seen until the aircraft was *ca.* 100 m parallel from it. Based upon locating the collared bison, we derived a correction factor *a posteriori* and applied this factor to the sample unit prior to the statistical analyses.

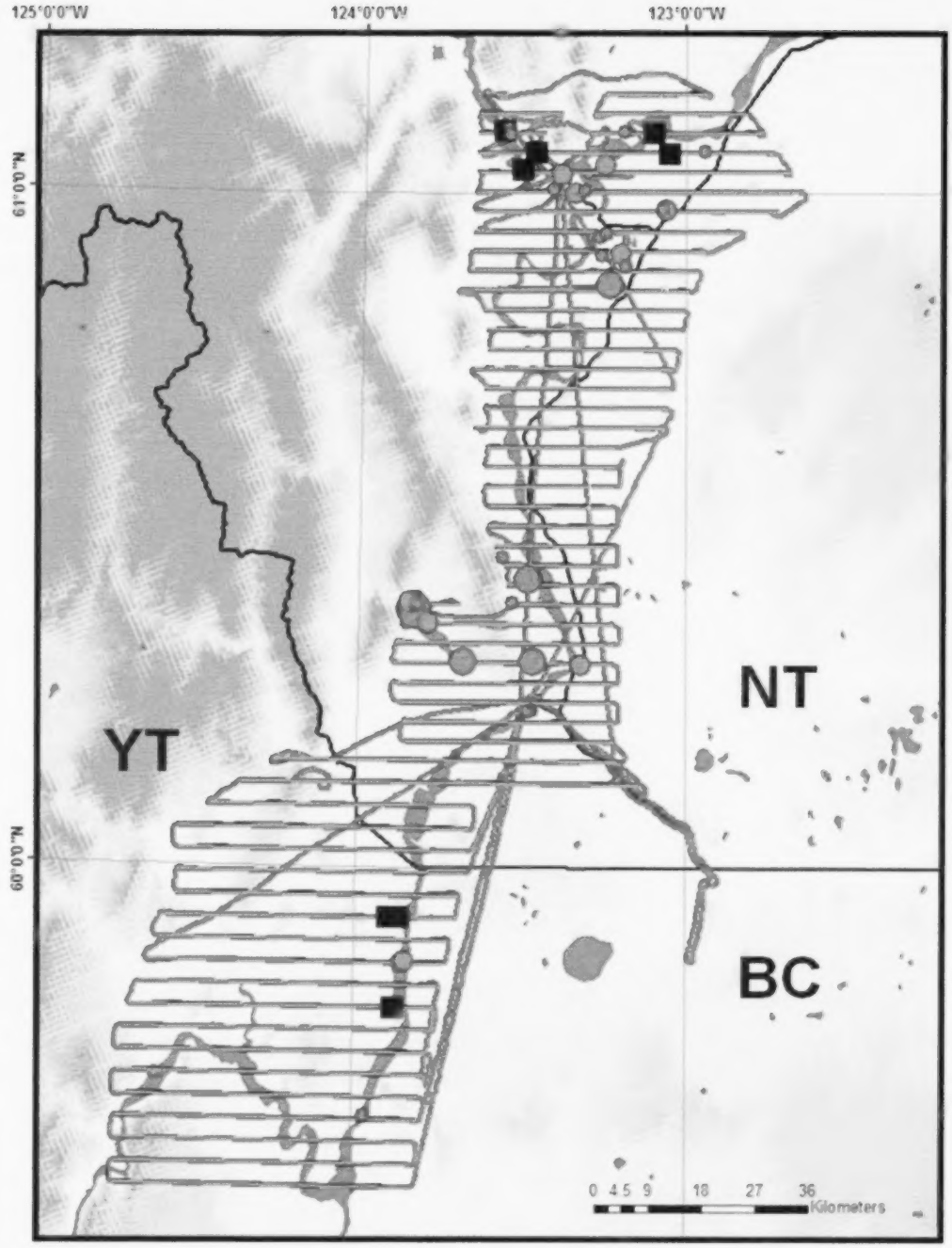

Figure 3. The lines flown during the survey and observations of bison groups. Red circles indicate bison groups, black squares indicate bison sign.

Landsat 7 orthoimages (raster images in UTM NAD83 projection) received through 2003 were mosaiced together to form a map that encompassed the entire bison survey area[1]. All flown transect lines were mapped onto this resulting map of thematic mapper (TM) data for the survey area. On the map, dense forested habitat has a distinct color. We determined the total length of dense forested habitat flown (if any) for each transect and subtracted it from the transect length. For the dense forested habitat length flown on transect, we reduced the observation swath to 100 m per side of the aircraft as the area surveyed; for the remainder of the transect that was not dense forested habitat, we used 500 m per side swath as the area surveyed and calculated the surveyed area accordingly for each of the 55 transects.

Using the 200 m sightability in forested habitats and including calves observed on transect, the population estimate was 431 ($\pm$ 213, 95% CI; CV=0.247). The total count for the Liard Highway corridor was 0 animals and covered an area of 56.7 km^2 based upon a spaghetti transect width allowing for a 1.5 km wide area of view for 37.8 km transect flight.

Sixty-nine of 79 moose and one otter were observed on transect lines; no caribou were observed. Signs of two different packs of wolves were observed during the survey.

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[1] The images can be downloaded from the Northwest Territories Centre for Geomatics website (www.geomatics.gov.nt.ca)

Figure 4. An example of the mosaiced map from the northern part of the survey area. The survey area is indicated by the yellow line.

DISCUSSION

Aerial population surveys in March, using the line transect technique, have been conducted to estimate population sizes of both the Mackenzie and the Nahanni wood bison populations previously (Larter et al. 2000, Larter et al. 2007). Bison distribution during most of the year tends to be dispersed throughout the landscape and highly clumped, with large mixed sex-age groups and small male-only groups, which are often solitary animals (Larter 1988, Gates and Larter 1990). Conducting surveys in the winter provides the added advantage of observing tracks recently left by bison. However, the majority of the Nahanni winter range is forested, with major river drainages, mountains and deep valleys bisecting it. Large open sedge-dominated meadows are rare but there is an abundance of smaller oxbow meadows associated with rivers.

Larter et al. (2007) suggested that by having radio collared bison prior to the next population survey a sightability correction factor could be determined, the survey area could be better delineated, and a more precise population estimate could be achieved. The 2011 population estimate had a lower coefficient of variation than the 2004 estimate (0.25 versus 0.32). Part of this can be attributed to the increased length of transect lines in the Liard River Valley between Fort Liard and Nahanni Butte for the 2011 survey. The increased width of the survey area was directly attributable to locations of collared bison expanding the bison distribution. In 2011, bison were more evenly distributed throughout the survey area and fewer transects were flown where no bison were observed than in 2004.

During a six month period following the survey, collared animals were located well beyond the 2011 survey area boundary, resulting in an increased range of distribution for the population (Figure 1). Future surveys will have to take this into account. In July 2011, 212 bison were observed during the three day river-based classification survey. This is close to the lower 95% CI of the estimate from the March survey, but it also includes newborn calves.

The estimated population number in 2011 has not changed much from that estimated in 2004 (431 versus 403). However, substantially more bison were observed in 2011 than in 2004 (186 versus 108) but 92 of those bison were observed off transect in 2011. Local residents are still concerned that the Nahanni bison population will demonstrate a similar rapid increase in size and range of distribution, as was observed over a 25-year period with the Mackenzie population (Larter et al. 2000). Based upon the data from classification surveys, there has been a relatively constant ratio of the number of calves/100 adult females since the population survey in 2004. Annual overwinter survival of calves estimated from these surveys also remained relatively stable since 2004 with a slight drop recently (Figure 5). These demographic data do not support a continually increasing population but more of a relatively stable population.

Nahanni bison are susceptible to drowning as they frequently swim the Liard River, but we lack data on number dying this way each year. However, multiple drowning events have occurred in the Nahanni as in other bison populations. During winter 2008-09, 13 bison fell through thin ice and drowned in the creek draining Fish

Lake. In addition, we have record of another 13 individuals that drowned between 2004 and 2011. Motor vehicle collisions have more recently caused mortalities. Larter and Allaire (2007) documented seven bison being killed in motor vehicle accidents from 2004 to 2006 with an additional four being killed from 2006 to the 2011 survey (N. Larter unpublished data).

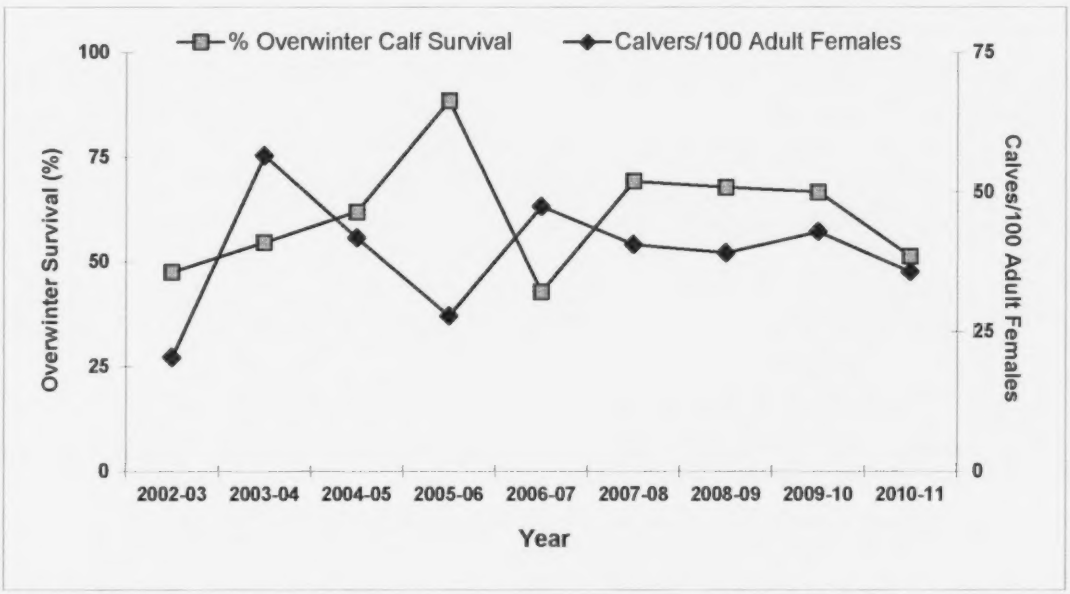

Figure 5. The estimated overwinter survival of bison calves (%) and the number of calves/100 adult female bison, based upon July classification surveys, for years 2002/03 to 2010/11.

Between the 2004 and 2011 surveys, two bison carcasses were found which appeared to have died from natural causes. In addition, 12 bison were either dispatched as a public safety measure in Fort Liard or illegally shot (N. Larter unpublished data). Bison continue to be hunted under quota. During the period between the two surveys, the annual quota was two animals; the annual quota was

never taken. However, in July 2011, the annual quota increased to seven animals; three animals were taken under the new quota during its first year.

Currently, the Nahanni population is free of the diseases of tuberculosis (*Mycobacterium bovis*) and brucellosis (*Brucella abortus*), and no anthrax (*Bacillus anthracais*) has been detected. Just recently, it has been reported that there is strong evidence that *Mycobacterium avium* ssp. *paratuberculosis* (MAP) is present. In captive bison, Johne's disease caused by the cattle strain of MAP, is a chronic debilitating disease that causes severe weight loss and is fatal. Clinical signs have not been found in wild bison populations and the significance of this disease to the health of wild bison populations is currently unknown (Woodbury et al. 2006).

Although the number of documented mortality events may be small, these are just the known documented events. For a small population, like the Nahanni, mortalities from motor vehicle accidents and removals in addition to natural mortality may reduce the opportunity for population growth. The lower capacity for population growth may be further exacerbated by the presence of MAP. Unless the current conditions change, we believe it is unlikely that the Nahanni population will go through a period of rapid increase as was seen in the Mackenzie population.

We plan to continue our multi-jurisdictional cooperation and coordination for the management of the Nahanni population. We anticipate deploying additional collars on the population prior to the 2015 winter aerial survey for another population estimate. Demographic surveys will be continued annually.

ACKNOWLEDGMENTS

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APPENDIX I

List of transect lines, their total length, the length of closed habitat, and number of animals observed on transect[1]. The number of animals on transect includes calves of the year that are likely to be recruited into the population.

Transect Number	Total Length (km)	Length Closed Habitat (km)	Number of Bison	Number of Moose
1	49.307	31.710		1
2	49.719	18.906	2	1
3	50.133	20.691		
4	50.541	10.234		1
5	50.876	12.941		
6	51.208	18.031		3
7	51.688	24.946		1
8	51.714	19.064		4
9	50.900	17.542		2
10	50.238	13.969		1
11	49.737	8.921	4	2
12	48.998	18.006		1
13	48.190	19.691		2
14	47.533	16.284		2
15	48.245	14.978		2
16	48.728	13.279		
17	49.134	21.055		
18	44.403	14.949		
19	60.235	11.717		1
20	58.058	10.394		
21	35.537	7.783		
22	36.026	5.619		
23	36.568	7.873		
24	37.032	4.250		2
25	37.549	8.577	30	
26	37.185	13.529		1
27	35.700	6.718	7	3
28	26.185	7.321	6	
29	17.904	3.261		
30	18.112	2.942		1
31	21.707	1.954		
32	21.400	2.418		
Transect	Total Length	Length Closed	Number of	Number of

Number	(km)	Habitat (km)	Bison	Moose
33	21.705	2.568		1
34	22.046	1.292		3
35	21.107	3.412		
36	21.806	3.109		
37	31.176	2.794		1
38	30.774	4.115		
39	32.020	6.323		1
40	33.596	1.892		
41	31.492	5.542		
42[1]	31.447	5.800		
43	33.369	7.314		
44	38.610	5.723	19	
45	38.354	4.135		2
46	39.571	6.460	5	5
47	44.617	7.645	1	1
48	50.496	10.154	6	1
49	55.280	11.895	10	
50	51.886	16.521	5	3
51	50.650	15.636	1	3
52	37.598	11.701	2	1
53	39.086	7.975		4
54	22.112	7.779		1
55	5.196	0.882		2

[1] One otter was observed on transect 42.

APPENDIX 2

Detailed descriptions of the flight legs conducted during the survey. Distance flown includes commuting to and from and between transect.

Date	Transects Flown	Departure Time	Flight Time (H)	Departure Weather	Distance Flown (km)
15 March[1]	20-38	0951	4:35	-16C; Overcast; 10km/h N wind	810
15 March[1]	11-15	1516	2:09	-12C; High overcast; 10km/h N wind	378
16 March	To Nahanni Butte	0812	0:30	-18C; Sunny ≤25% cloud; calm	90
16 March[2]	48-55	0908	2:51	-18C; Sunny ≤25% cloud; calm	497
16 March[2]	39-47	1238	2:39	-15C; Sunny ≤25% cloud; calm	439
16 March	From Nahanni Butte including Liard Hwy	1540	1:12	-15C; Sunny ≤25% cloud; calm	203
17 March[1]	16-19	0830	1:40	-13C; 50% cloud cover; 15km/h N wind gust to 20km/h	289
17 March[1]	1-10	1042	4:07	-13C; 50% cloud cover; 15km/h N wind gust to 20km/h	737

[1] Flights started at and ended from Fort Liard airport.

[2] Flights started at and ended from Nahanni Butte airstrip.